Report on Graphics and Animation Systems

Videography's technical editor outlines the past, present and future of these exciting systems

by Mark Schubin

We have reached a situation totally unprecedented in the history of television. Imagine someone telling you that, thanks to electronic breakthroughs, television lighting would never again require lights; or that sound could be recorded or transmitted without need of microphones; or that actors would no longer be necessary.

Well, that's the sort of thing that manufacturers are telling the industry about graphics and animation, and, even if they're stretching the truth today, it's likely that all of their predictions will come true in the future. No more art cards. No more transfer type. No more photostats. No more markers. No more typesetting. No more paints, inks or brushes. No more scissors, knives, paste or glue. No more frame-by-frame animation.

You can't point to one particular electronic breakthrough. Electronic graphics and animation has been insidiously creeping up on the film and television industries for years. In fact, it has grown from many, seemingly unrelated technologies into a single, gigantic force that might someday—well, perhaps I'll save the most awesome prediction for later.

What are the many facets of this incredible trend? They include character generators, electronic "drawing" systems, electronic "paint" systems, video image manipulators, still-frame storage devices, video synthesizers, motion controllers, computer graphics programs, high-speed computers and personal computers.

Let's start with character generators. Today, of course, words appearing on a computer screen are so commonplace that some people think computers always had such screens. Not so. The very first computer data screens were actually developed by CBS Laboratories, applying television technology to the computer problems of stockbrokers and the NASA space program.

Even the most rudimentary character generators had a certain amount of graphics capability, just as typewriters had. Observe:

```
      aaaaa
    a     a
  a   a a   a
a     a     a
a   a   a   a
  a   aaa   a
    a     a
      aaaaa
        a
    aaaaaaaaaa
        a
        a
      a   a
    a       a
    aaa     aaa
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Yet, no pencil, pen or paintbrush manufacturer needed to fear such crude devices, which could only deliver what came to be known as "computer-style" characters. However, typesetters got their first shock when CBS Laboratories introduced the so-called "graphic-arts-

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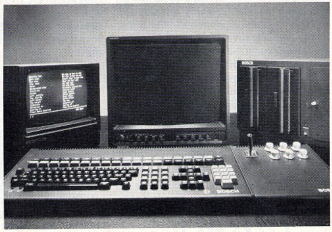
Time Arts Producer I graphics system with Lumena software.



The FGS-4000, Bosch's graphics and animation system.

quality" character generator, the Vidifont.

In the 14 years since the introduction of the Vidifont, more and more character generators have been introduced with better and better looking characters. Perhaps Quantel's Cypher represents the current state of the art, offering not simply typefaces created by engineers or computer programmers, but actual licensed typefaces from the libraries of Letraset, Monotype, and International Typeface Corporation. Combined, these constitute the bulk of the typefaces available to graphic artists in any form: electronic type, phototype, "hot" type, transfer type, etc.

Today, of course, a large proportion of the type seen on a television screen comes from electronic character generators. So does a large proportion of the simple graphics screens, such as those showing statistics in sports and news shows.

Graphics generation was a natural outgrowth of character generation, as colored characters and backgrounds were developed. Make the backgrounds red, white, and blue, and they form an excellent graphic for election reportage. Add a few special characters, such as stars, circles or lines, and, suddenly, entire graphs can be constructed at a character generator keyboard.

Vidifont (now sold by Thomson-CSF), Chyron (descendant of the company that made the storage device for the first Vidifont), Bosch (whose character generators date back to a Telemation unit introduced in 1969), 3M (with a slightly younger ancestor in Datavision's 1970 character generator), and other brands, all offer a certain amount of graphics capability in their character generators. Yet, one of the first devices that could actually be called a TV graphics generator would have to be Dubner's CBG series, which created graphics that leapt off the screen in ABC's coverage of the 1980 Winter Olympics.

Dubner's device was ideal for the simple, yet powerful graphics that are integral to presenting the news, sports and weather. In fact, weather reporting relies so heavily on graphics that keyboard control was deemed insufficient for many of the recently introduced weather graphics systems. To draw fronts and pressure zones, weather graphics devices turned to electronic styli, "drawing" on electronic surfaces.

The use of electronic drawing systems in television is much older than the Dubner CBG series of graphics generators. Interand's Telestrator series allowed weathercasters to draw fronts, sportscasters to draw plays, and newscasters to circle points of interest, all in real time, directly on a television screen. Now AT&T is also in the business of selling real-time electronic drawing systems to the television industry with its Gemini electronic blackboard.

While the Telestrator and Gemini serve certain purposes well, in some ways they are to electronic paint systems what computer-style character generators are to Quantel's Cypher. Like character generators, electronic paint systems have their origins in the 1960s, and many systems are closely related to one another. Xerox's Superpaint (a direct ancestor of Aurora's systems) was probably the first seen on national television, when PBS began using it in 1975.

In 1980, Ampex's AVA was the first electronic paint system sold to the television industry (though CBS used it in the 1978 Super Bowl). It was also the first one withdrawn from the market (though it has since been re-introduced). AVA was a descendant of New York Institute of Technology's paint systems, in turn descended from Superpaint. NYIT's own systems are available through Computer Graphics Lab, Inc.

GRAPHICS SYSTEM MARKETERS*

AVL 320
So Park Rd.
Tinton Falls NJ 07647
(201) 544-8700

Ampex 321
401 Broadway
Redwood City CA 94063
(415) 367-4161

Apis 322
2960 S.W. Temple
Salt Lake City UT 84115
(801) 484-6030

Aurora Systems 323
185 Berry St.
San Francisco CA 94107
(415) 777-2288

Beston/McInnis-Skinner 324
15315 S. 169 Hwy.
Olathe KS 66061
(913) 764-1900

Robert Bosch Company 325
PO Box 31816
Salt Lake City UT 84131
(801) 972-8000

Cable Graphic Sciences 326
2939 Larkin
Clovis CA 93612
(209) 292-0246

Chyron Corporation 327
265 Spagnoli Rd.
Melville NY 11747
(516) 249-3081

Colorgraphics Weather Systems 328
5725 Tokay Blvd.
Madison WI 53719
(608) 274-5786

Digital Graphic Systems 329
2629 Terminal Blvd.
Mountain View CA 94043
(415) 962-0200

Dubner Computer Systems 330
158 Linwood Plaza
Fort Lee NJ 07024
(204) 592-6500

Fairlight Instruments 331
2945 Westwood Blvd.
Los Angeles CA 90064
(213) 470-6280

Grove Video 332
16851 Oakmont Ave.
Gaithersburg MD 20877
(301) 840-5801

Interand 333
3200 W. Peterson Ave.
Chicago IL 60659
(312) 478-1700

Laird Telemedia 334
242 S. 2570 W.
Salt Lake City UT 84119
(801) 972-5900

MCI/Quantel 335
3290 W. Bayshore Rd.
Palo Alto CA 94303
(415) 856-6226

Power-Optics 336
341 Main St.
Collegeville PA 19426
(215) 539-5300

Scion 337
12310 Pinecrest Rd.
Reston VA 22091
(703) 476-6100

Texscan/MSI (Compuvid) 338
3855 S. 500 W.
Salt Lake City UT 84115
(801) 262-8475

Thomson-CSF Broadcast 339
37 Brownhouse Rd.
Stamford CT 06902
(203) 965-7000

3M Broadcast 340
3M Center Building 225-3N
St. Paul MN 55144
(612) 733-9073

Time Arts 341
3436 Mendocino Ave.
Santa Rosa CA 95401
(707) 576-7722

Via Video 342
3135 Old Ironside Rd.
Santa Clara CA 95050
(408) 980-8009

Xiphias 343
13470 Washington Blvd.
Marina del Rey CA 90292
(213) 821-0074

ANIMATION SYSTEM MARKETERS*

Computer Graphics Lab 344
405 Lexington Ave.
New York NY 10174
(212) 557-5130

Computer Image 345
2475 W. Second Ave.
Denver CO 80223
(303) 934-5801

Computer Operations 346
5001-J Forbes Blvd.
Lanham MD 20706
(301) 459-2100

Datamax 347
1965 Pratt Blvd.
Elk Grove Village IL 60007
(312) 981-8288

Frank Woolley & Co. 348
529 Franklin St.
Reading PA 19602
(215) 374-8335

Interactive Motion Control 349
8671 Hayden Pl.
Culver City CA 90230
(213) 559-6146

Lyon Lamb Video Animation Systems 350
4521 Empire Ave.
Burbank CA 91505
(818) 843-4831

Oxberry 351
180 Broad St.
Carlstadt NJ 07072
(201) 935-3000

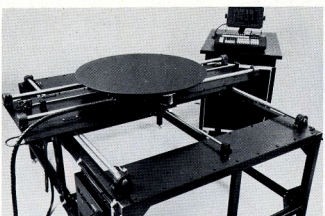
Warren Smith 352
PO Box C
Ocean Gate NJ 08740
(201) 269-6795

* A number of the graphics systems listed also offer animation capabilities. Please consult product brochures which are obtainable by contacting companies directly or using Reader Service Numbers with the Reader Service Cards bound within this issue.

The top-of-the-line paint systems allow an artist to paint in an almost limitless number of colors, with an almost limitless variety of brushes, including brushes that just don't exist in real life—such as one that deposits a trail of corporate logos wherever it's moved. Most paint systems also offer built-in character generators, and Quantel's Paint Box offers the same licensed typefaces as does Cypher.

Peculiarly, however, Apple's Macintosh computer offers exactly the same sorts of features with its MacPaint program. With appropriate accessories, a Macintosh can even retouch photos. This is one way the elaborate computer graphics system at Acme Cartoon, a Dallas-based production house, has been used. And the Macintosh is not the only personal computer offering a paint system.

Personal computer magazines are filled with so many paint programs and systems



Interactive Motion Control animation stand and computer.

Dubner CBG-2 with keyboard, tablet, monitors and rack.

that it would be impossible to list them all here. Some seem more applicable to the video world than others. Sony's SMC-70 computer offers a Superimposer accessory that perfectly matches the technical characteristics of a video system. Time Arts' Producer I system seems to offer all of the features of the top-of-the-line paint systems at a tiny fraction of the cost.

So why pay more? Well, there are trade-offs between quality, features, money and two types of time. The quality issue in computer graphics has two characteristics: resolution and "jaggies." Resolution determines how sharp graphics will look. Some top-of-the-line systems offer graphics sharp enough for 70mm film; some bottom-of-the-barrel systems look crude even on slow-speed videocassettes. Sharpness costs money.

So does smoothness. Jaggies are the little stair-step edges that appear on diagonal and curved lines on certain computer graphics systems as a result of the rectilinear way in which the computer generates images. The battle cry of top-of-the-line system designers is "No more jaggies!" and some of them even wear T-shirts with a set of stair-steps surrounded by the red-slashed international "no" circle. If you want to be a jaggie-buster you've got to pay.

Features and the first type of time are pretty straightforward. If you want more features, you've got to pay more, and the same is true if you need to work fast. Almost any computer can generate graphics as detailed as anyone could want, as long as you've got the time to specify what each and every single dot of resolution in the picture is supposed to be. Few graphics systems make you work that hard, but some are faster than others.

The other kind of time relates to the steady growth of technology. If a Macintosh computer with MacPaint had been available in 1970, some network would probably have paid hundreds of thousands of dollars for it. Fifteen years from now, aside from any value it might have as an antique, the same system probably won't be worth more than $50. Next year something will come out that will do the job more cheaply . The question is, can you afford to wait, or can you afford not to wait?

Everything mentioned to this point is related to graphics, but only to still-frame graphics. What do you do with a still image? Well, in the old days of non-electronic graphics, you could mount the image on something and move either the image or the camera around. Or, you could create a series of still images and shoot them one frame at a time to create an animated sequence.

Both of these techniques are still in use, and both have been affected by the technological revolution. A simple example is the Scene-Sync from Power-Optics. You can mount your graphic on the Scene-Sync's easel, place that easel in front of one camera and place another camera on the Scene-Sync controller. Then, the second camera can shoot someone in the foreground, assured that whatever panning or tilting is done on the foreground camera can be precisely matched by the background easel. As a result, an actor chromakeyed onto a shot of Switzerland, for example, can walk around and be realistically followed by the camera. Perhaps the very zenith of this technique is practiced by Los Angeles' Magicam, which can produce images of actors dancing in a doll house you'd swear was full size.

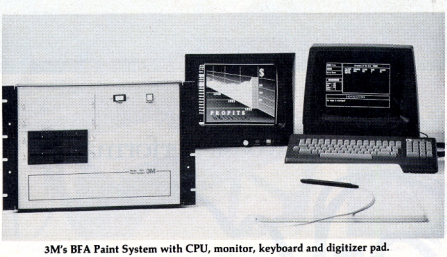
In film animation, a simplified version of this technique is obtained with the animation stand, a platform that can be adjusted to introduce a precise amount of linear or rotary motion between frames. In video, the animation stand has given way to the motion controller, which offers precise, repeatable motion in several degrees of freedom (left-right is one degree of freedom, up-down is another, clockwise-counterclockwise another, and so on).

Charlex, a New York production house, uses motion controllers in conjunction with video special effects devices and a paint system to perform such feats of video magic as the *National Enquirer* commercials. Charlex's most elaborate motion controller, a robotic camera-holding arm from Elicon, can be instructed to repeat a human's motion, to carry out inhuman camera moves, or to repeat moves in a scaled-down or scaled-up version to match the size of models. For work that doesn't require as elaborate a controller as Elicon's arm, Charlex might use one of its simpler, animation-stand-like motion controllers, such as Warren Smith's.

Video manipulation devices offer animation capability to still graphics, whether generated electronically or not. The simplest, Rutt's Repositioner, can be used in conjunction with a switcher's wipe or key, allowing a still graphic to be panned—something not always possible to do with a camera when the graphic is generated electronically in the first place. The most elaborate video manipulator to date, Quantel's Mirage, can turn a flat graphic into a sphere, and spin it, roll it up like a sardine can lid or make it move in and out like a rubber membrane, among other possibilities.

Yet, sometimes even this manipulation is not enough, and traditional frame-by-frame animation of film must be used. Film-style animation was utterly impossible with video equipment until the advent of electronic editing. Long before the first CMX editing system or SMPTE time code, Ampex's Editec editing controller, for its 2-inch quadruplex videotape recorders, actually allowed single-frame animation to be recorded, one very painstaking frame at a time. Later, Ampex's ESS electronic still store made the process faster, simpler, safer and better.

Today, still stores are available from a variety of companies and range from single-frame freezes, built into certain frame synchronizers and video manipulators, to the 13.3-minute recording capability of Panasonic's Optical Memory Disc Recorder. The most incredible capacity, however, is on Sony Broadcast's BVH-2500 Delta T 1-inch type C videotape recorder, which can record in a still-frame mode for as long as 126 min-



3M's BFA Paint System with CPU, monitor, keyboard and digitizer pad.

utes (226,800 individual frames) on a single reel of tape.

Able to record at slower-than-normal speeds as well, the BVH-2500 offers yet another film-style flexibility to video animation. Traditionally, a motion controller operating at, perhaps, 10 miles an hour could be used with a film camera running at half speed to create the illusion of action taking place at 20 miles an hour. Until the advent of the BVH-2500, video could only operate in real time, putting tremendous demands on the motors of motion control systems.

Sometimes it's not necessary to move anything to achieve animation. One rudimentary animation function offered by some electronic paint systems is "playback," a high-speed look at just how the graphic was drawn in the first place. By judicious planning, playback capability can fill many animation needs.

Another rudimentary system is color mapping and changing. With this technique, different positions of an object are drawn as different colors, and the graphics system is instructed to make all but one of those colors invisible in each frame. The end result, depending on the artist's capability, can look like very smooth animation. One doesn't need to use a computer for such an effect, however. Rotating light polarizers, such as those available in the Motionmaster system from Frank Woolley, can animate more conventionally generated graphics.

The concept of swirling electronically through a sea of colors originated in video synthesizers. These are not digital computers, but special purpose devices built (or, sometimes, thrown together) with common analog circuitry, just as early audio synthesizers were. Some video synthesizers, such as David Stringer's "Mr. Animation," used at the Toronto production facility Advertel, incorporated a TV picture tube shot by a camera. The scanning of the picture tube could be affected by the synthesizer to collapse or transform images, but the camera would put out solid video, which could then be colorized by the synthesizer.

Computer Image's synthesizers, used so effectively by Dolphin Productions, were similar. In creating its dream sequences and animation effects for *Sesame Street*, on the other hand, Reeves Teletape simply jabs the output of an audio oscillator into the side of a camera (a capability Ikegami now includes as standard equipment with the "Dream" button on its HK-322 camera).

There are a lot of ways to create video animation. Even an electronic drawing system like the Telestrator offers animation beyond simple drawing. Select the stick figure on the Telestrator control panel, and, wherever you move the stylus, the little figure will walk—it won't simply change position; it will move its legs and walk.

The most advanced computer animation systems, however, perform two other miracles. One is called "inbetweening," sometimes shortened to "'tweening." With this feature, the artist draws only key frames, while the computer automatically draws all the frames in between. Depending on the complexity of the action sequence, inbetweening might offer a 20-to-1 or 30-to-1 reduction in drawing time. The "filling" mode, with which the artist can instruct the computer to color in designated outlines, saves still more time.

The second miracle involves "simply" programming the computer of an animation system to render its own animation—frequently, three-dimensional-looking animation, with appropriate light, shading and perspective (something not even the greatest Disney animation offered).

Now, unfortunately for most television producers, the necessary equipment leaves even the realm of the Mirage and enters the world of high-speed computing. New York Institute of Technology's Computer Graphics Laboratory has created astounding sequences of a construction site "manned" entirely by robots. Unfortunately, it took years to create, even with powerful Digital Equipment VAX computers. The animation in the film *The Last Starfighter* was created by Digital Productions with a multi-million-dollar Cray supercomputer. The Cray operates so fast that the hardest part of its design seems to have been cooling it off—the next generation of Cray supercomputers will operate entirely within a bath of fluid to remove the heat from high-speed circuits.

One exciting capability of advanced computer graphics systems is called "mapping." The Mathematical Applications Group, Inc. (MAGI), which created the Light Cycles, tanks, and Recognizers in the movie *Tron*, developed a technique for "mapping" any texture onto any computer-generated surface. Using the technique, they've created a "chrome-plated dog" that reflects a scene in a parking lot just as if it were really there. Mirage maps video images onto calculated shapes, such as spheres and cylinders. NYIT has mapped a woman's real, videotaped face onto a moving animated character.

Okay, get ready. Here comes the big one: If a face can be mapped onto an animated character, and if three-dimensional-looking animation is so realistic, then is there any reason why someone can't make a new John Wayne movie? The perhaps frightening answer is: no, there is no reason.

Well, no reason except practicality. Today's computer systems and programs—even the most advanced Cray supercomputers—are not up to achieving such a task in a hurry. Some years ago, you could have hired an artist to draw a John Wayne movie, one frame at a time. Unfortunately, the artist would probably be dead before a few seconds were completed. Today, with electronic painting, in-betweening and mapping, perhaps we've advanced to the stage where, in an artist's lifetime, a few minutes might be created.

We've advanced to the point where Fairlight Instruments can offer a combination paint/animation/video synthesizer/video manipulator for about the cost of the lowest priced character generator; a point where a Radio Shack Color Computer, running a low-cost program, called Talk Head (from Colorware), can generate a recognizably human face that mouths the words that are audibly generated from typed-in text, all in real time. Next year's supercooled, superfast Cray will not make new John Wayne movies possible, but last year's modified Dubner CBG was already coloring old black-and-white movies. Today's video graphics and animation systems are leading the way.

The first new John Wayne movie will probably look and sound like a cartoon. Later movies will still be easily distinguished from the originals by the studious. Experts will be able to distinguish even the next series from the real thing. But, some day...